# 90 mm and 35 mm Dipoles

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# Progress and Status

## Status of 35 mm aperture dipole

- The spacing between the three pole wiggler and dipole is increased. The center of three pole wiggler is ~30 cm from the end of iron. The iron to iron gap is ~20 cm.
- Saddle coils are replaced by flat racetrack coils.
- Racetrack coils with smaller bend diameter (2” instead of 4”) are examined.

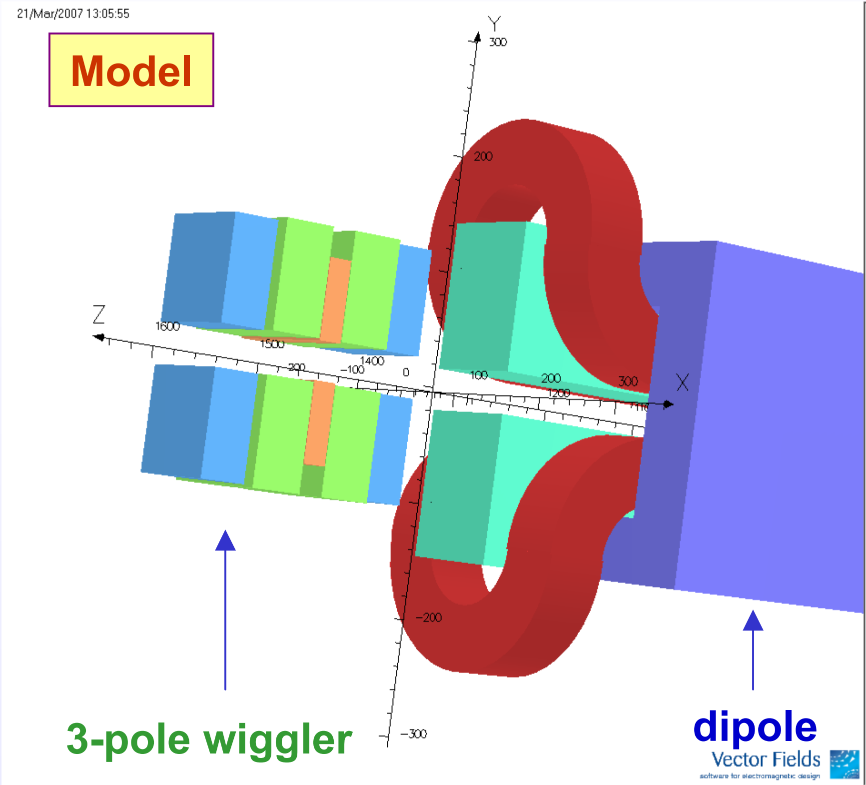
All of above work requires 3-d analysis – a time consuming undertaking both in terms of human time and computer time.

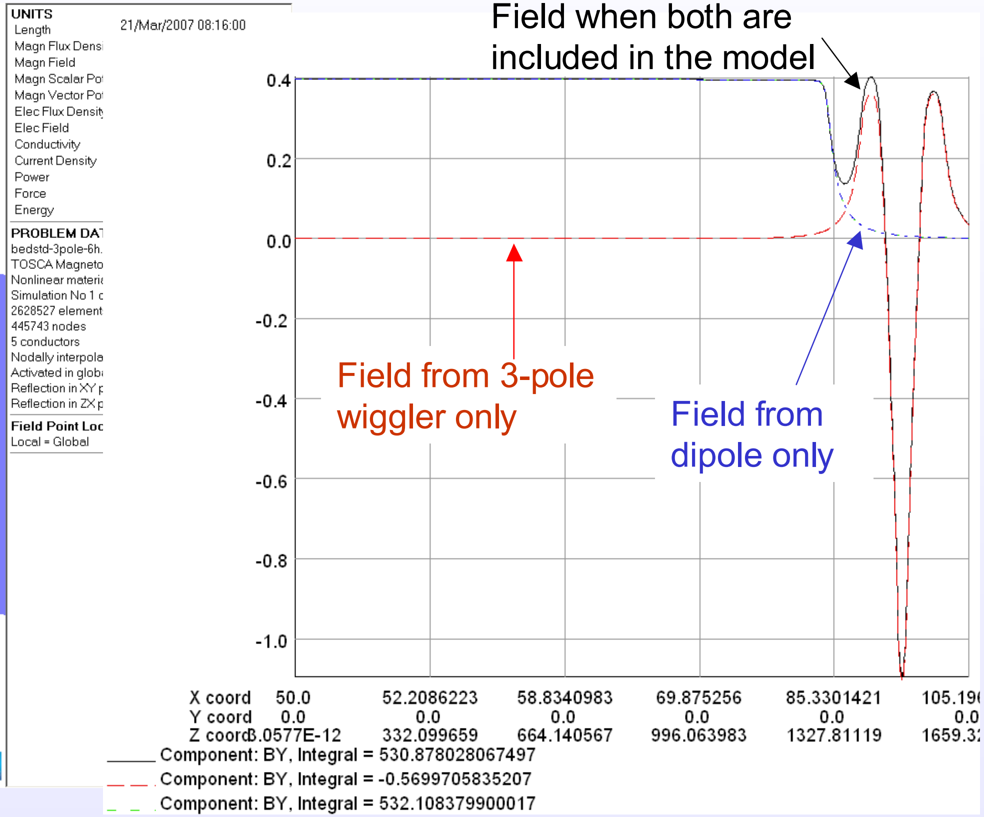
## First optimized design of the larger aperture (90 mm) dipole:

- A number of 2-d designs have been examined.
- The desired goal is that the two dipoles (35 mm and 90 mm) run from the power supply.

# Previous Design with ~9 cm iron to iron gap + "saddle coils" and "extended pole" for space saving features

Superconducting Magnet Division



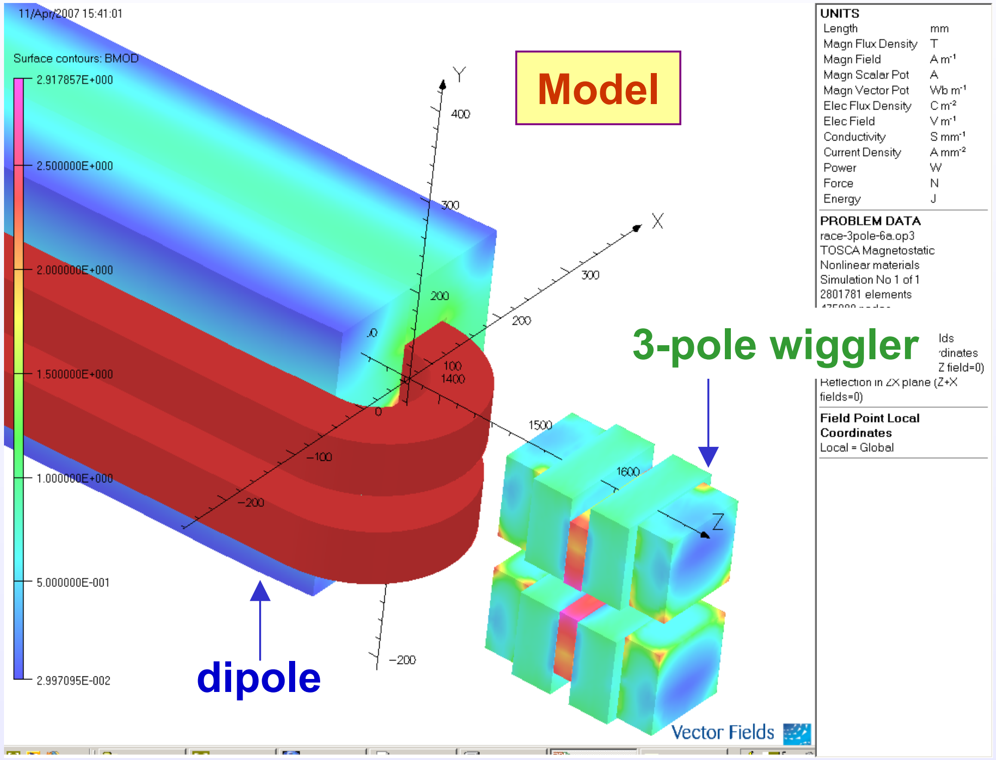

- Compare the integral field of the two when they are close and when they are far off (only dipole)
- But what about the field harmonics ?

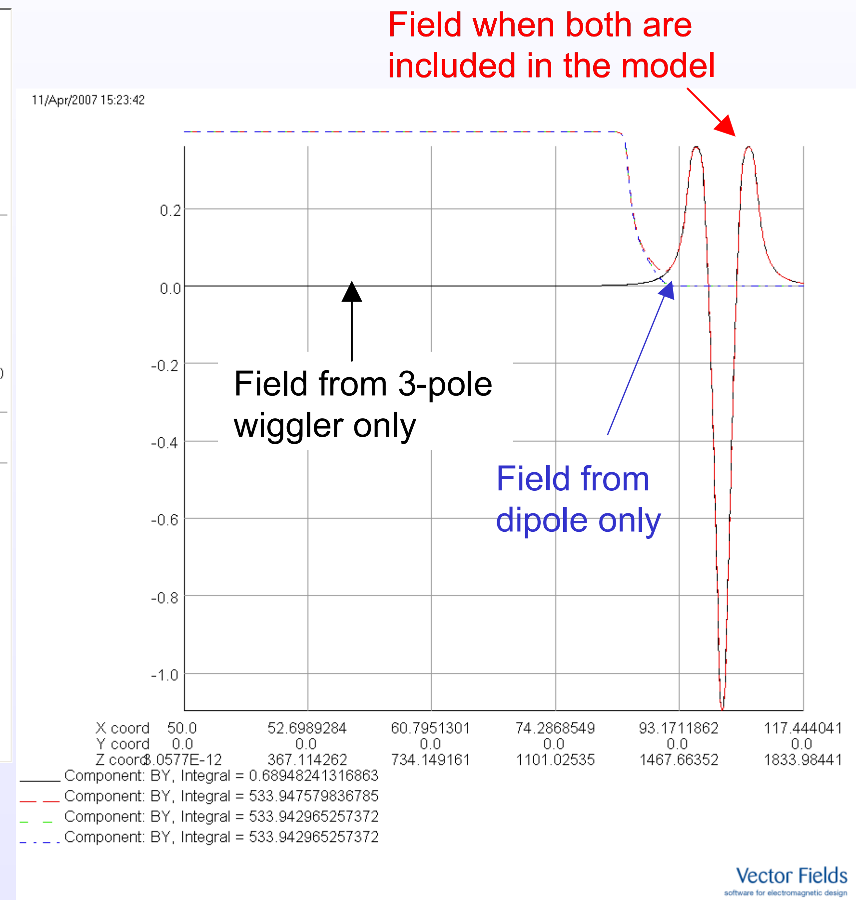
Two field profiles with the same integral field may have vastly different field harmonics.

Generally more up and down in the field fall-off, indicates larger peaks in local harmonics (however, integral harmonics may be more relevant)

# New design with racetrack coils ~20 cm iron to iron gap (~ 9 cm coil to iron gap)

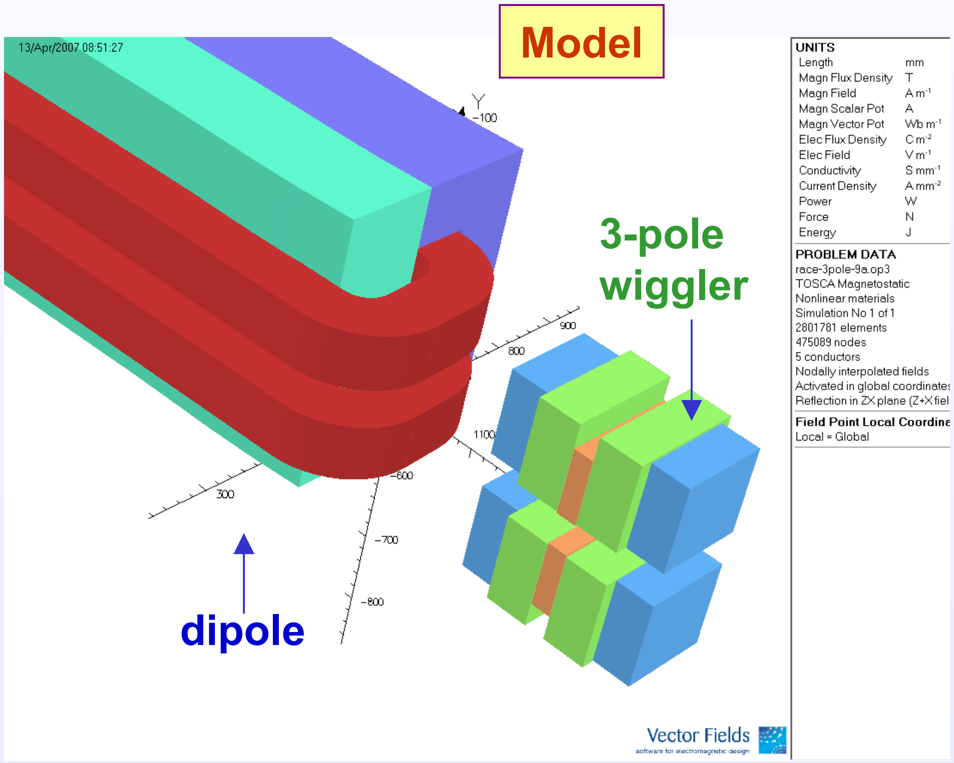


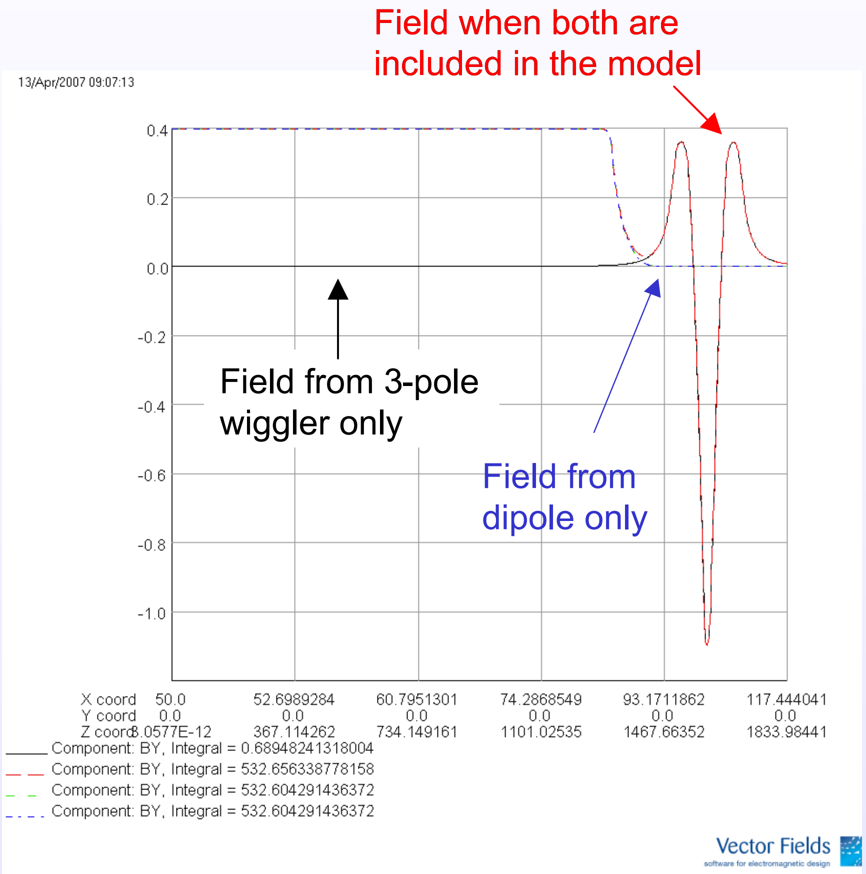



- There is virtually no interference (within computational errors, < few parts in 1,000) between the fields of three pole wiggler and dipole.

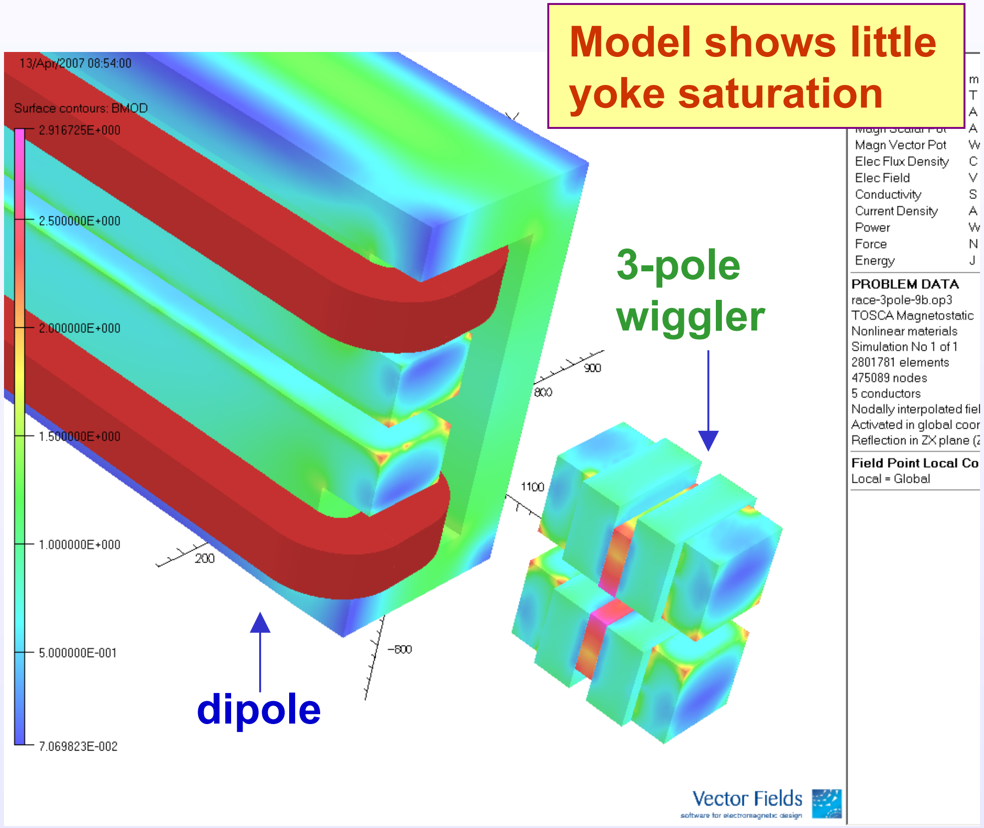
# New design with 2" bend diameter racetrack coils (~ 11.5 cm coil to iron gap)

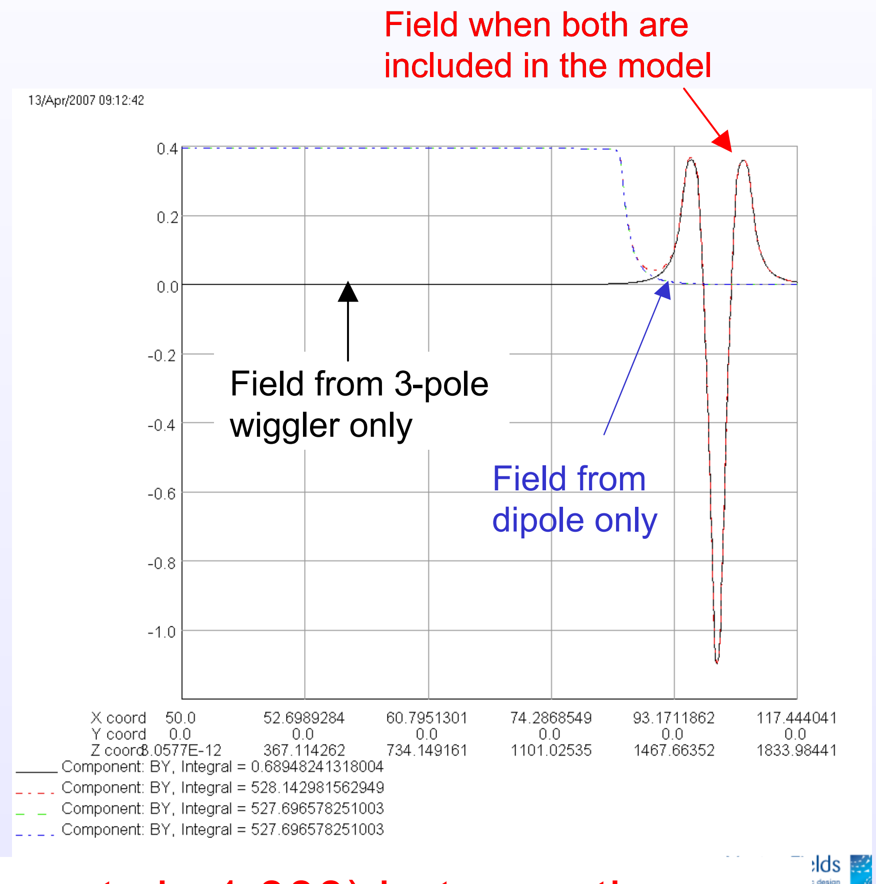



- There is virtually no interference (within computational error, < few parts in 1,000) between the fields of three pole wiggler and dipole.

# Newer design with 2" diameter enclosed racetrack coils (~ 18 cm coil to iron gap)




- There is virtually no interference (< few parts in 1,000) between the fields of three pole wiggler and dipole.
- **This design allows racetrack coils and ~18 cm of free space for whatever purpose at the expense of a little extra iron !**

# Larger Aperture (~90 mm) Dipole

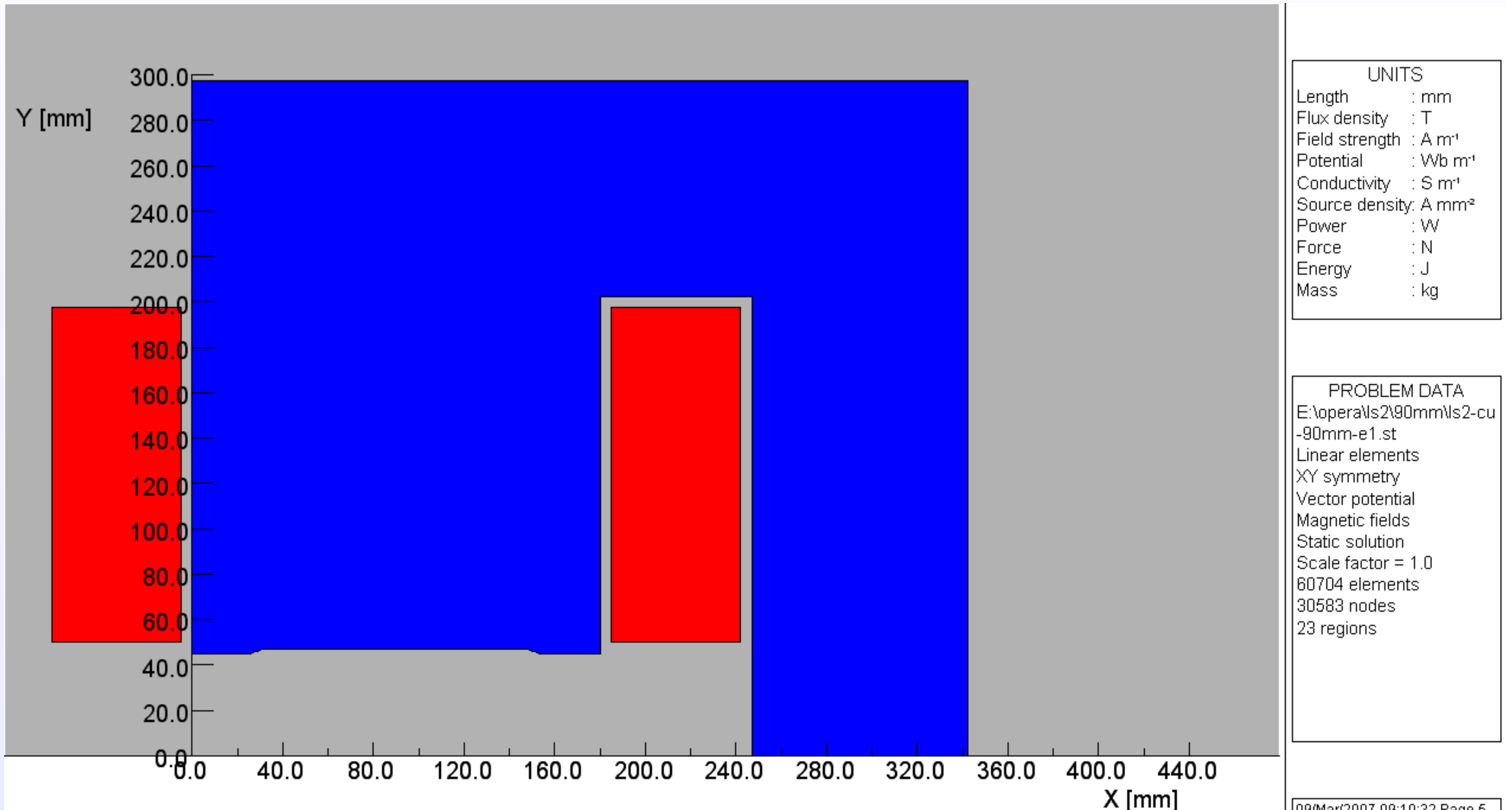
## First optimized design of the larger aperture (90 mm) dipole:

- A number of 2-d designs have been examined.
- Yoke and coil cross sections are examined to make them as small as possible while satisfying the field quality requirements.
- 3-d design (which takes much longer) will be optimized next.
- The desired goal is that the two dipoles (35 mm and 90 mm) run from the power supply.
- In 2-d design, the goal is to obtain that within a few percent and then re-optimized the 90 mm dipole design after comparing 3-d profiles.
- Note that 90 mm pole gap is just a nominal number and it can be a few mm more to obtain a better compliance of the transfer function matching.

# Larger Aperture (~90 mm) Dipole

**Same conductor is chosen as in 35 mm dipole. The number of turns are adjusted.**

**Transfer function of this dipole is similar to 35 mm aperture dipole (~1% deviation).**




Vector Fields
software for electromagnetic design

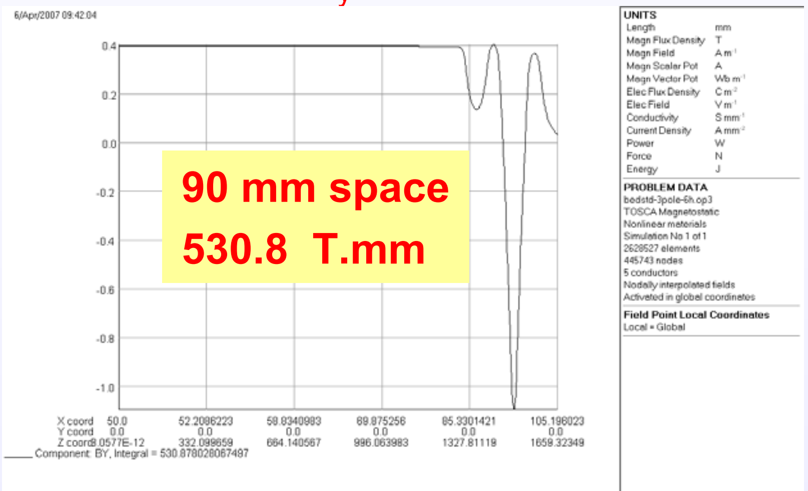
**The above initial design meets the following stated requirements:**

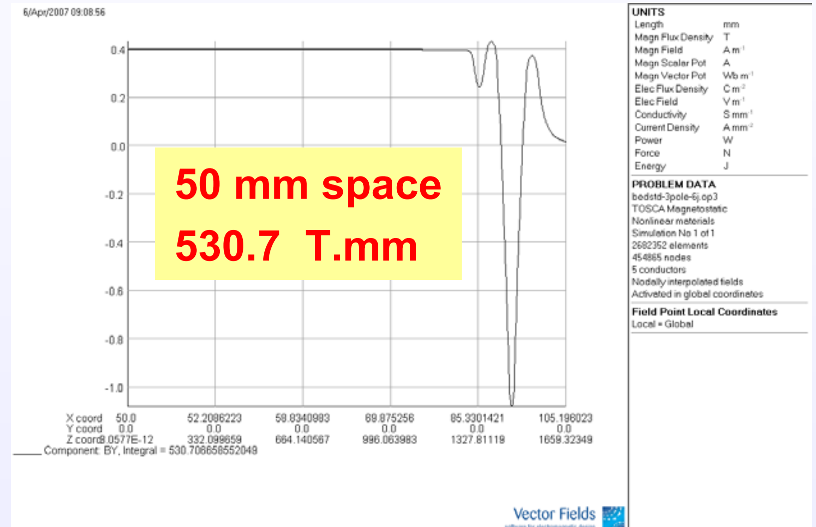
- o Nominal Field – Bo = 0.40T to 0.50T
- o Field Homogeneity BX,BY=1x10-4
- o Good field region BX +/- 20mm, BY +/- 10mm
- o Nominal Current density in the coil cross section 2 Amps/mm$^2$

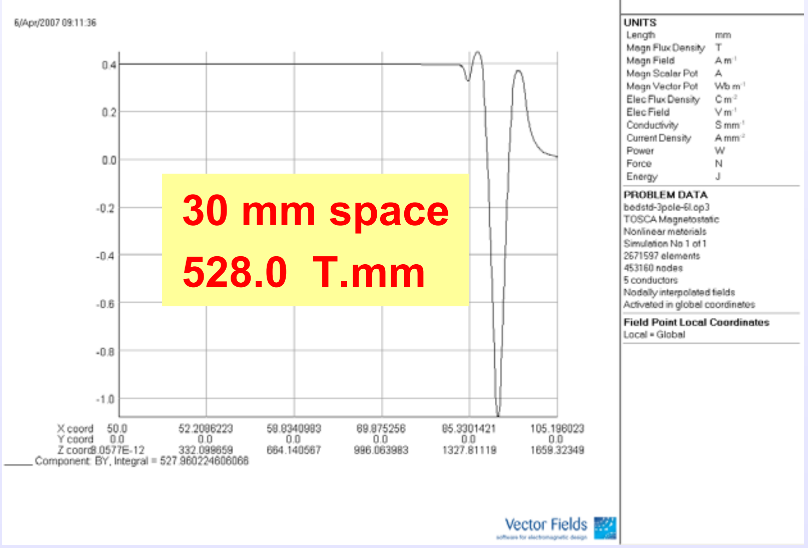
Slides from the supposedly last presentation
(not shown)

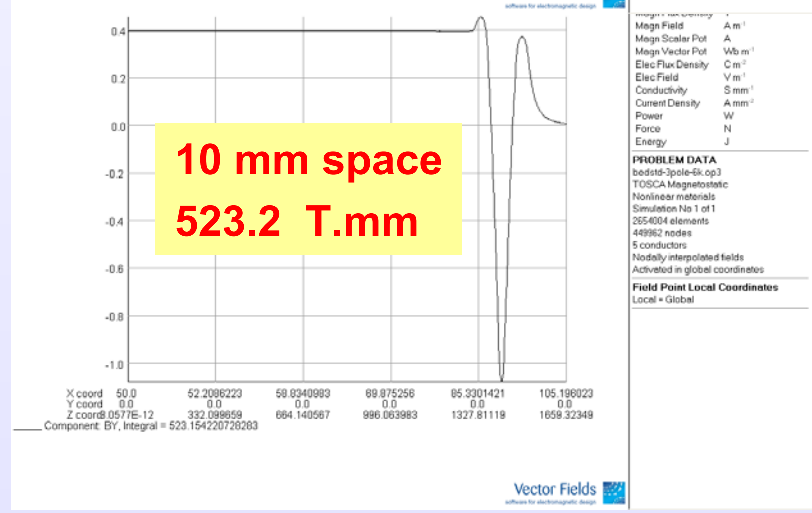
# Comparison of Integral Field

Integral field ($B_y$) of ½ dipole by itself in this model is: 531.8 T.mm (error ~0.6 T.mm).



# Comparison of the End Fields in Various Designs